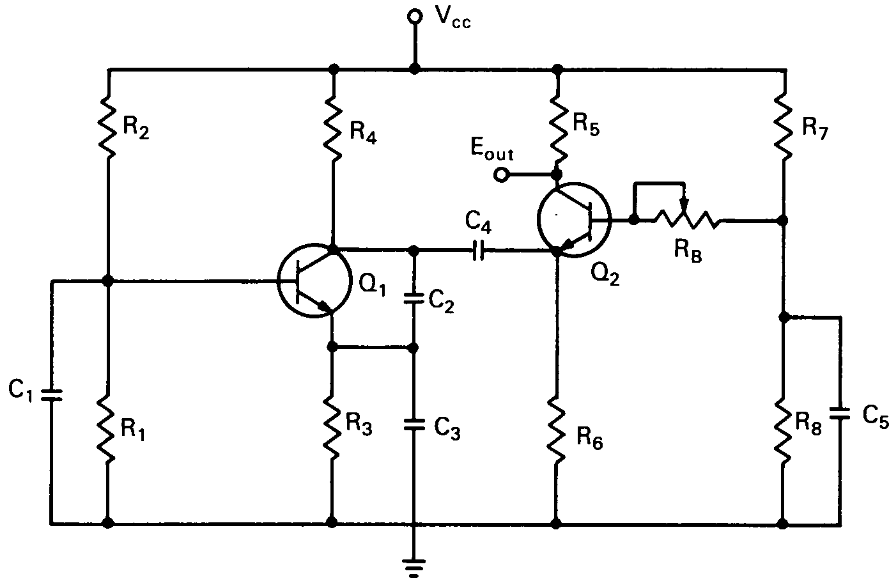
NASA TECH BRIEF

Microelectronic Oscillator



The inability of microminiature component technology to fabricate suitable inductors places a serious limitation upon the design engineer. Circuits employing inductors, such as tuned amplifiers and oscillators, are difficult to achieve by conventional techniques. Thin film inductors are limited to values of inductance directly proportional to area. Monolithic technology has yet to produce suitable inductors.

To surmount the inductor problem, a bipolar transistor operated in the grounded base configuration is employed as the inductor. This configuration may be gainfully employed using thin-film hybrid technology and may also be applicable to monolithic technology. The value of inductive reactance obtained from such a configuration is equal to:

$$jX_L = \frac{jR_B F_T}{F}\left[\frac{1}{1+\left(\frac{F_T}{F}\right)^2}\right].$$

Where R_B is the base resistance, F_T is the transistor's transitional frequency, and F is the frequency of operation. In series with the inductive reactance is a resistance whose value is:

$$R_L = \frac{R_B}{1+\left(\frac{F_T}{F}\right)^2}$$

(continued overleaf)

The quality factor of the inductor is equal to $\frac{F_T}{F}$, and the value of inductance may be varied by varying the value of R_B.

The basic oscillator configuration is shown in the schematic. The oscillator is a modified Colpitts Oscillator, chosen for its amenability to accepting the inductive transistor. Resistors R_1, R_2, R_7, R_8, R_3, and R_6 comprise the biasing networks for transistors Q_1 and Q_2, while C_4, C_1, and C_5 are bypass capacitors. R_4 and R_5 are the load resistors for transistors Q_1 and Q_2. Capacitors C_2 and C_3 simultaneously form the tuning capacitances and, in conjunction with transistor Q_2 (the inductive transistor), form the feedback network. Resistor R_B is a tuning resistor that varies the frequency by varying the equivalent inductance and, therefore, the frequency of oscillation.

For crystal control, capacitor C_1 is replaced by the crystal, and operation takes place at the series resonant frequency of the crystal.

Notes:

1. No further documentation is available.
2. A related innovation is described in NASA Tech Brief B69-10063, March 1969. Inquiries may also be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland 20771
   Reference: B69-10064

Patent status:

No patent action is contemplated by NASA.

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